

REGIONAL DATA ANALYSIS AND EVALUATION

Seat Belt Use and Health Care Costs in Montana and Idaho

Contract DTNH22-10-C-00188, Task Order 02, Task C.5.15

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About This Report

The goal in this task was to update a report previously prepared by the Harborview Injury Prevention Center that examined the costs of medical care for unbelted individuals, indexed to inflation, for the States of Montana and Idaho. The planned analyses were to take into account a number of hospital and emergency care costs items such as number of admissions, length of hospital stay, requirements for use of intensive care services, and other accrued hospital charges; plus, other cost items such as Medicaid and insurance costs.

Separate analysis results for Montana and Idaho address the relation of seat belt use to injuries and resulting health care costs, and the potential for health care cost savings through enforcement of seat belt laws leading to an increase in seat belt use and a reduction in the number and severity of injuries in motor vehicle crashes. Specific research questions of interest included: 1) What preventable costs do taxpayers in the States of Montana and Idaho incur each year to pay for injured, unbelted occupants; 2) With a specified impact of primary enforcement on seat belt use, what savings could be expected with the adoption of primary enforcement seat belt laws in Montana and Idaho?

NHTSA provided copies of the previous reports as a starting point for performing this task. However, these documents were but brief summary sheets stating the results of the prior analyses, containing few details concerning the methodology used to derive them. Subsequent contacts to Region 10 staff¹ and to the previous report's lead author² sought clarification regarding the following:

1. Please provide any reports documenting the data sources and methodologies used in the prior Harborview analyses for Idaho and Montana. If nothing 'official' exists, please describe as best you can recall the sources and methods used, including assumptions that were applied in calculations used to determine estimates. In particular, in the second bullet of each of the 1-pagers describing the Idaho and Montana findings, an estimate is provided for the number of unbelted individuals hospitalized for care (887 in MT, 821 in ID), and for the number of admissions that could have been prevented if a seat belt had been used (817 MT, 757 ID). *How were these numbers obtained or calculated?* And in the 4-page Montana report, Table 2 provides data from Montana Level 2 trauma centers. In that table, it indicates there were 2,663 unbelted patients admitted for injuries resulting from a motor vehicle crash, representing 58.4% of the MVC population admitted for their injuries. It seems to us that a trauma database could underestimate the number of hospitalizations for MVC injuries and overestimate hospital costs, because of the criteria for reporting patients to the trauma database (i.e., next level up in care resources required). *So again, how was the 887 number derived, particularly as it is smaller than the 2,663 identified in the trauma database?*
2. To the extent hospital discharge data were used for Montana analyses, *what assumptions or calculations were applied* (e.g., did she apply percentages derived from a trauma database--which does include belt status, as opposed to the hospital discharge database which does not include restraint status) *to determine number of belted and unbelted hospital admissions, and other statistics documenting the differences between these groups with respect to costs, payers, and length of stay?*
3. *How were emergency care costs derived for unbelted individuals? Are emergency room / outpatient visits included in hospital discharge databases?* Even if they are, these data are not coded by restraint use. Emergency room/outpatient data are not included in trauma registries (as far as we understand), as one of the criteria is the initiation of full or partial trauma team activation at the facility, or hospitalization for 48+ hours, or one of several surgery types (that would require admission to the hospital).

¹ Mr. Max Severeid, Regional Program Manager, NHTSA Region 10, August 18, 2012.

² Dr. Beth Ebel, Harborview Medical Center, August 28, 2012.

It became apparent following these contacts, that the update attempted in this task would face significant constraints in terms of the availability of sources for key variables in the cost analysis; and in the access to, and quality of, data that could be provided on a timely basis by those sources that could be reached and who agreed to support our efforts. Our data acquisition targets were as follows:

Data Sought	Source(s) Contacted	Results of Inquiry
Counts of injured motor vehicle occupants in 2010 and 2011, by police-reported injury severity and seat belt use (Montana)	Montana Department of Transportation, State Highway Traffic Safety Office*	Received
Counts of injured motor vehicle occupants in 2010 and 2011, by police-reported injury severity and seat belt use (Idaho)	Idaho Transportation Department	Received
Idaho Trauma Registry Data for hospitalizations meeting trauma registry inclusion criteria, resulting from a motor vehicle crash (with an understanding that this source underestimates total number of hospitalizations resulting from MVC and does not include ER outpatient visits. Includes duplicates when patients transferred to other hospitals that report to the registry). Requested extraction of anonymized, line by line data for each admission, describing primary payor source, hospital length of stay, injury severity code, police-reported injury classification, restraint use, number of ICU days, and number of ventilator days	<ul style="list-style-type: none"> Idaho Hospital Association Idaho EMS Bureau 	Received 2010 data; 2011 not yet available. Does not contain costs.
Requested extraction of anonymized line-by-line hospital discharge data describing cost data by seat belt status and primary payor from 1 hospital in Idaho (to estimate costs). Also includes length of stay and injury severity score.	St. Alphonsus Regional Medical Center	Received 2011 data
Montana Trauma Registry Data for hospitalizations meeting trauma registry inclusion criteria, resulting from a motor vehicle crash (with an understanding that this source underestimates total number of hospitalizations resulting from MVC and does not include ER outpatient visits. Includes duplicates when patients transferred to other hospitals that report to the registry). Requested anonymized, line by line data for each admission, describing primary payor source, hospital length of stay, injury severity code, charges billed.	Injury Prevention Coordinator, EMS & Trauma Sections Section, Montana Dept. of Public Health & Human Services	Received 2010 and 2011 data
Requested line-by-line anonymized Statewide Hospital Discharge Data (HDD) from Montana that includes every hospitalization resulting from a MVC, to get accurate counts of admissions (however, the number would be underestimated because E-Codes are only 87% complete for injuries). Includes payor source and charges, but is not linked to Office of Highway Data, so no restraint status is available. (Idaho has no HDD)	Injury Prevention Coordinator, EMS & Trauma Sections Section, Montana Dept. of Public Health & Human Services	Line-by-line data could not be provided. Received summary data on length of stay and charges by payor for 850 hospitalizations in 2010 and 2011, but not by seat belt status or injury severity.
Hospital Discharge Data from Harborview Trauma Center in Washington State (the only Level 1 trauma center in a 4-state area, where the most severely injured patients are transported), for patients transported there from hospitals in Idaho and Montana. Requested anonymized line-by-line data for each patient describing length of stay, primary payor, charges, injury severity, and restraint status.	Harborview Hospital, Washington State	Was not provided

Data Sought	Source(s) Contacted	Results of Inquiry
Data from a study in Washington State describing the proportion of injured motor vehicle crash occupants hospitalized to total number injured within each injury severity category (none evident, possible, non-incapacitating, incapacitating, fatal)	Dr. Beth Ebel, Harborview Injury Prevention and Research Center	Received

* Via the Injury Prevention Coordinator, EMS & Trauma Sections Section, Montana Dept. of Public Health & Human Services.

The present analyses applied all data elements obtained from the sources noted above, and developed estimates (*as documented herein*) where sought-after data could not be obtained in this task. Analysis results are reported on the pages that follow, separately, for the States of Idaho and Montana. A concluding section applies NHTSA data regarding the expected impact of primary enforcement on belt use rates, to project the magnitude of potential savings in health care costs in each State from such a policy.

Seat Belt Use and Health Care Costs in Idaho

- During the 2-year period from 2010 to 2011, 283 passenger vehicle occupants were killed on Idaho roads. Of these 283 occupants killed, 160 (57%) were not wearing a seat belt.³
- Drivers wearing seat belts were less likely to be injured in crashes, and those who were injured sustained less severe injuries, compared to drivers not wearing seat belts (see Figure 1, which shows injury severity provided by the Idaho Transportation Department for reportable crashes.). Unbelted occupants were over 15 times more likely to die from their injuries and 4 times as likely to sustain an incapacitating injury compared to belted crash-involved occupants³. Hospital-assigned Injury Severity Scores (ISS)—an anatomical-based scoring system which correlates with expected mortality, the need for hospitalization and intensive care, length of hospital stay, cost and treatment complexity, disability, and quality of life—also showed that the use of seatbelts decreased injury severity, for injured motor vehicle occupants admitted to hospitals (see Figures 2 and 3).⁴

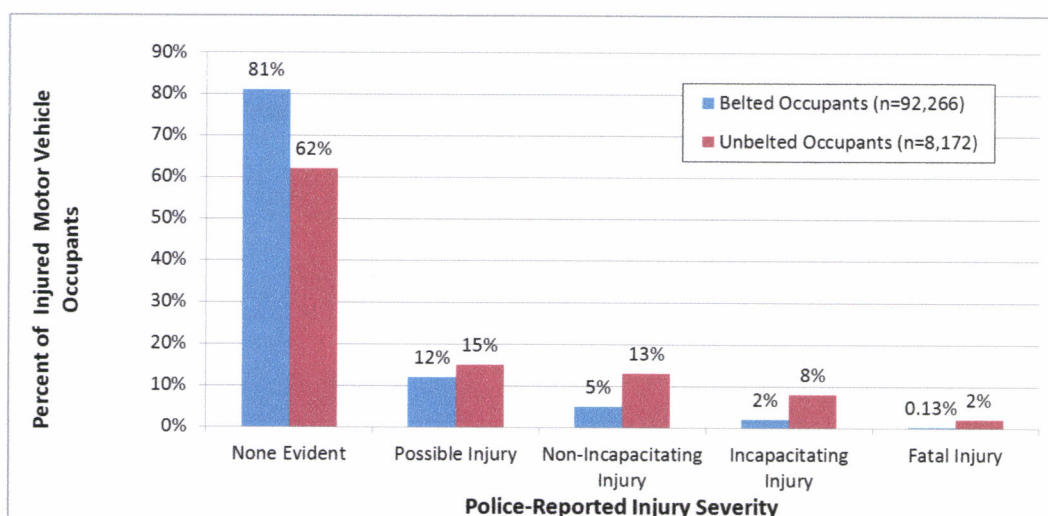


Figure 1. Police-Reported Injury Severity by Seat Belt Use for all Occupants Injured in Motor Vehicle Crashes in Idaho in 2010 and 2011.

³ Data on restraint use by injury severity for the year 2010 were provided by the Idaho Transportation Department (ITD), as a person-level cross-tab report for all reported crashes (see Appendix A). Data for the year 2011 were obtained from www.itd.idaho.gov/ohs/ClickIt/SBCosts.htm, also prepared by ITD. Where counts were reported for “unknown” belt status, we assigned the proportion of belted to unbelted occupants within each injury severity category to re-distribute the “unknowns” into “restrained” or “unrestrained” categories.

⁴ Idaho Trauma Registry Data for 2010 admissions and data from St. Alphonsus Regional Medical Center for 2011 admissions, with E-Codes indicating Motor Vehicle Crash.

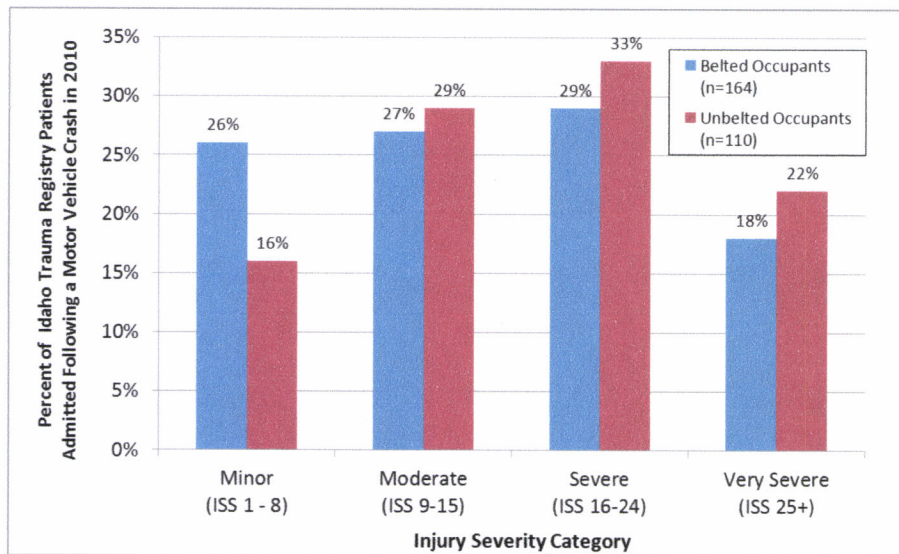


Figure 2. Hospital-Assigned Injury Severity Score by Restraint Use, for Patients Included in the Idaho Trauma Registry following a Motor Vehicle Crash in 2010.

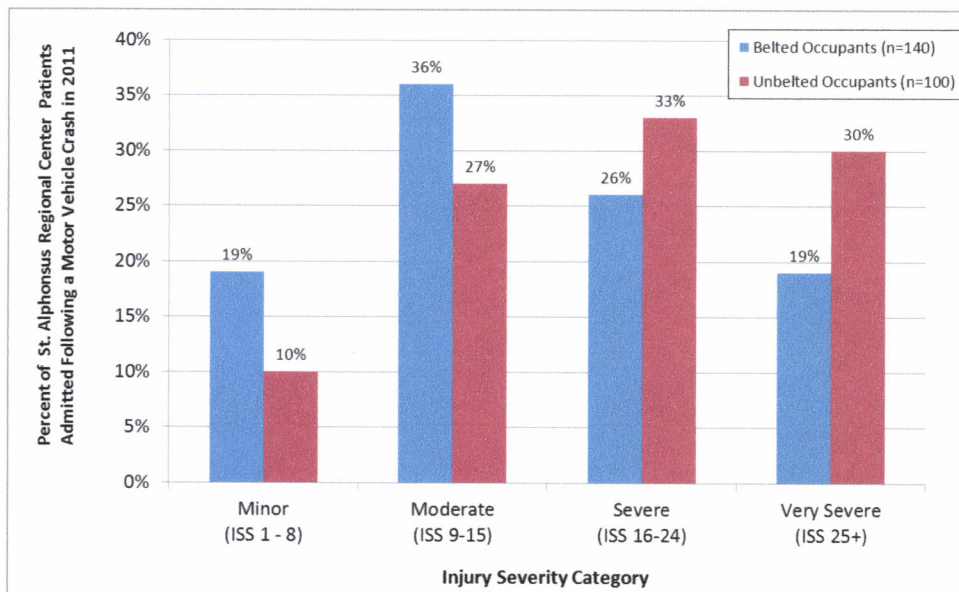


Figure 3. Hospital-Assigned Injury Severity Score by Restraint Use, for Patients Admitted to St. Alphonsus Medical Center following a Motor Vehicle Crash in 2011.

- Among Idaho crash occupants who required admission to a hospital in 2010 following a motor vehicle crash, 39% were not belted, and 61% were belted⁵. Similar percentages were observed in 2011; 37.5% unrestrained and 62.5% restrained⁶.
- During this same time period (2010 – 2011), an estimated 747 **unbelted** injured vehicle occupants were hospitalized for care⁷. An estimated 522 of these hospitalizations could have been prevented if the occupants had worn a seat belt⁸.
- Unbelted occupants were slightly less likely than belted occupants to have medical or automotive insurance to pay for their hospitalizations (88% vs. 91% in 2010; and 79% vs. 85% in the 2011), and were slightly more likely to have their hospital costs paid from federal or state sources (Medicare or Medicaid) than belted occupants (7% vs. 5% in 2010; 17% vs. 13% in 2011). (See Figures 4 and 5)⁹.
- Approximately 4% to 5% of unbelted occupants have no insurance (self-pay patients); their hospital costs are ultimately paid for by the state of Idaho. Combining the payor categories of Self-Pay, Medicare, and Medicaid, between 12% and 21% of unbelted occupants have their hospitalization costs paid for by state or federal sources. This compares to 9% to 15% of belted occupants (see Figures 4 and 5).

⁵ Determined using 2010 Idaho Trauma Registry data for hospitalizations at 25 of Idaho's acute care hospitals meeting trauma registry inclusion criteria, and filtering out individuals with hospital length of stay < 1 day (as these are not admissions, but transfers either to home or another hospital), with the exception of those coded as deceased. Number of cases analyzed was 317. The occupant protective device field selected from the trauma registry for analysis was the Office of Highway Safety entry (coded from police report), as opposed to the hospital-coded entry for protective device. The analysis does not include data from patients transferred to Harborview Trauma Center in the State of Washington (e.g., those with the most serious injuries). Harborview Hospital trauma center data (the only Level 1 trauma center in the States of Washington, Alaska, Idaho, and Montana) were not available at the time this report was prepared.

⁶ Hospital discharge data were provided by St. Alphonsus Regional Medical Center for admissions resulting from MVCs 2011.

⁷ Proportion of crash occupants hospitalized by police-reported injury classification was calculated using proportions provided by Dr. Beth Ebel (Harborview Injury Prevention & Research Center) based on a larger study using probabilistic matching to link Washington police-reported crash data to Washington State Hospital discharge data. Proportions applied to the Idaho Transportation Department data were as follows: died (0.49744685), incapacitating injury (0.72990606), non-incapacitating injury (0.12669916), possible injury (0.02946386), none evident (0.00729243). These Washington data were used in Idaho, as Idaho has no hospital discharge database, which, if available and with linked data from the ITD, could be used to calculate actual proportions hospitalized by police-reported injury severity. Trauma Registry data do not include all hospitalizations resulting from a MVC (only those meeting trauma registry inclusion standards as described in the following link: <http://www.idahotrauma.org/ReportingStandards/Documents/Final%20ITRInclusionChart%20GFF%20111109.pdf>) Additionally, Trauma Registry data include duplicate admissions for patients transferred to other hospitals that report to the registry, making it an unreliable source for documenting total admissions.

⁸ Number of unbelted hospitalizations that could have been prevented if a seat belt had been worn was calculated by applying the proportion of the number of belted occupants hospitalized to the number of belted crash-involved occupants (2,456/92,266, or .0275) to the number of unbelted crash-involved occupants (.0275 x 8,172=225), and subtracting that from the number of unbelted crash occupants hospitalized (747-225 = 522).

⁹ Primary payor data for 113 unbelted patients and 187 belted patients meeting trauma registry inclusion criteria were included in the 2010 Idaho Trauma Registry dataset provided by the Idaho Hospital Association. Primary payor data for 81 unbelted and 139 belted patients admitted to St. Alphonsus Regional Medical Center in 2011 were included in the dataset provided by St. Alphonsus.

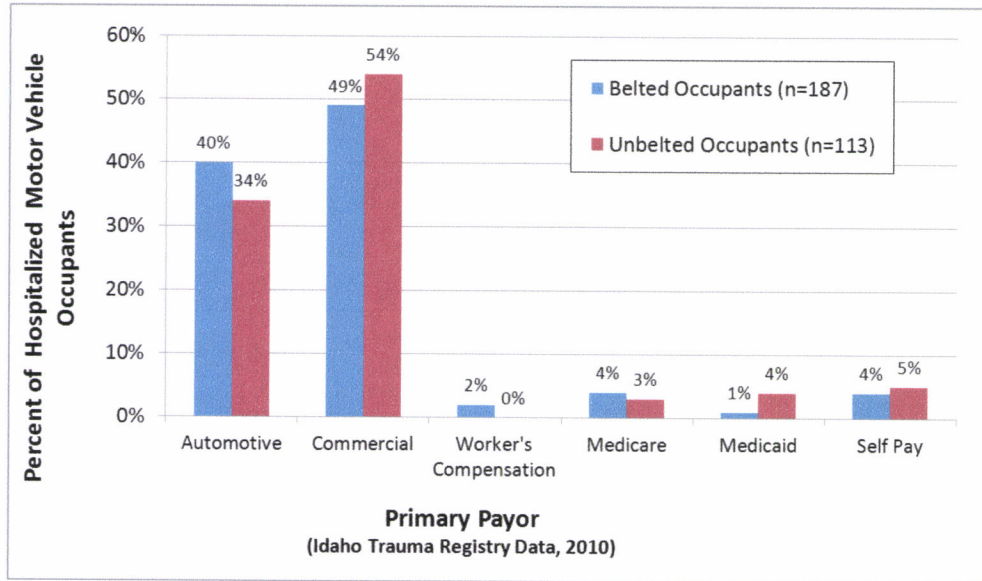


Figure 4. Primary Payor of Hospital Bill, by Seat Belt Use, for Idaho Patients Hospitalized following a Motor Vehicle Crash (2010 Trauma Registry Data).

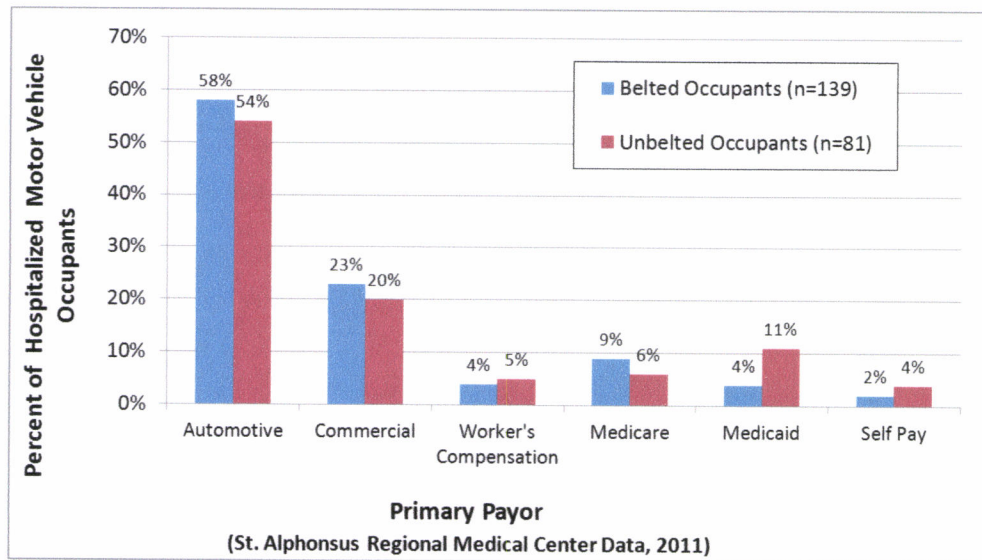


Figure 5. Primary Payor of Hospital Bill, by Seat Belt Use, for Idaho Patients Hospitalized following a Motor Vehicle Crash (2011 St. Alphonsus Regional Medical Center Data).

- Unbelted occupants had higher average hospital charges than belted occupants (\$37,481 vs. \$22,289), and had an average hospital stay that was 2.5 days longer than belted occupants (7.6 days vs. 5.1 days).¹⁰
- Caring for unbelted Idaho patients during this period (2010-2011) cost over \$37,132,209 in direct hospital charges, which could have been prevented through seat belt use. These costs result from three sources:¹¹
 - More hospital admissions: 522 individuals requiring hospital care for preventable injury (522 x \$37,481 average unbelted admission = \$19,565,082).
 - Higher costs per hospital stay: 225 hospitalized individuals requiring \$15,192 more for their care than belted occupants (\$3,418,200)
 - Costs for emergency care¹²: An estimated 9,711 unbelted occupants requiring emergency outpatient care, at an estimated average cost of \$1,457 each (\$14,148,927).
- On top of the hospital charges, doctor fees for unbelted occupants seen in the ER as well as those admitted to hospitals were estimated at \$7,426,442¹³, resulting in total hospital and physician charges for unbelted occupants at \$44,558,651 in 2010 and 2011 (an average of \$22,279,326 per year).
- The estimated costs paid by state and federal sources (Medicaid and Medicare) for unbelted occupants needing medical care in 2010 and 2011 ranged between \$2,681,965 and \$4,684,226 (an average of \$1,340,982 to \$2,342,113 per year).¹⁴

¹⁰ Idaho's Trauma Registry does not include cost data, and Idaho has no statewide hospital discharge database. For this analysis, data were obtained from one hospital (St. Alphonsus Regional Medical Center) for 2011 admissions resulting from MVCs. This figure therefore underrepresents charges, because it does not include the most severely injured patients who would have been transferred to a Level 1 trauma center (Harborview Trauma Center data were not available at the time this report was prepared). Cost includes only charges billed by the hospital; no physician fees are included, nor are costs for transport or rehabilitation.

¹¹ Costs were calculated from data provided by St. Alphonsus Regional Medical Center for patients admitted in 2011 as a result of MVCs, and do not include costs for patients transported and admitted to a Level 1 Trauma center. Costs also do not include ambulance transport fees, any separately billed physician fees, or rehabilitation facility costs. These costs were applied to the estimated number of crash occupants hospitalized in 2010 and 2011.

¹² There is no statewide registry of patients treated in emergency departments, by cause of injury. Estimated were based on 13 emergency visits for each admission due to motor vehicle crashes (Pers. Comm., Dr. Beth Ebel, 8/29/2012). The average cost of an ER visit was calculated based on data provided by the Centers for Disease Control Data and Statistics /WISQARS Cost of Injury Reports 2005 for motor vehicle crash injuries at http://wisqars.cdc.gov:8080/costT/cost_Part1_Finished.jsp and indexed to inflation for 2010 and 2011 using the inflation calculator and U.S. Medical Cost Inflation Data at <http://www.halfhill.com/inflation.html>.

¹³ Professional fees estimated at 20% of facility fees (Pers. Comm., Dr. Beth Ebel 8/29/2012). Does not include costs associated with patients admitted to Level 1 trauma hospitals (the most severely injured patients). Dollar amount refers to charges billed, and not those negotiated under agreements with large insurers.

¹⁴ The range is based on the charges billed for the 12% to 21% of unbelted occupants who were either self-pay, Medicaid, or Medicare (proportion in the Trauma Registry in 2010 was 12% vs. the proportion in the St. Alphonsus data for 2011, which was 21%) and then reduced by 50% using the Medicare cost-to-charge ratio. The percentages were applied to counts of (a) patients whose hospitalizations could have been prevented and their associated costs, (b) the balance of the hospitalizations with higher costs than belted hospitalizations, and (c) the estimated number of ER patients. Does not include costs incurred by patients admitted to a Level 1 trauma hospital, as these data were not available at the time this report was prepared.

Seat Belt Use and Health Care Costs in Montana

- During the 2-year period including 2010 and 2011, 325 passenger vehicle occupants were killed on Montana roads. Two-thirds of these individuals (219) were not wearing a seat belt.¹⁵
- Drivers wearing seat belts sustained less severe injuries in crashes, compared to drivers not wearing seat belts (see Figure 6). Unbelted occupants were 7 times more likely to die from their injuries and over twice as likely to sustain an incapacitating injury than belted crash-involved occupants.¹⁵ Hospital-assigned Injury Severity Scores (ISS)—an anatomical-based scoring system which correlates with expected mortality, the need for hospitalization and intensive care, length of hospital stay, cost and treatment complexity, disability, and quality of life—also showed that the use of seatbelts decreased injury severity, for injured motor vehicle occupants admitted to hospitals (see Figure 7)¹⁶.

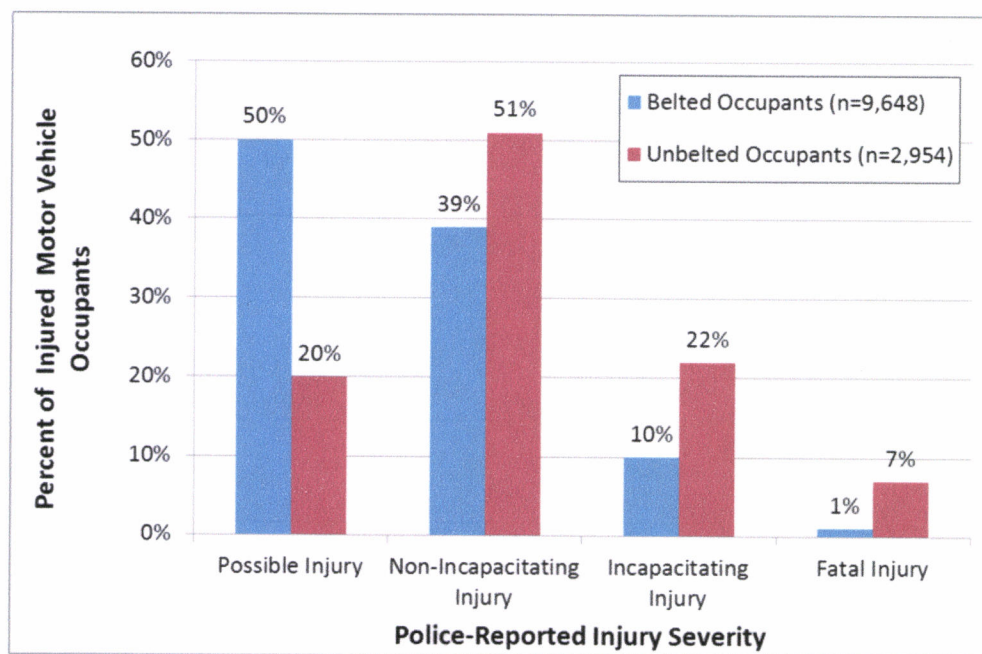


Figure 6. Police-Reported Injury Severity by Seat Belt Use for all Occupants Injured in Motor Vehicle Crashes in Montana in 2010 and 2011.

¹⁵ Data on restraint use by four categories of injury severity (possible, non-incapacitating, incapacitating, and fatal) were provided by the Montana Department of Transportation (MDT) (see Appendix B). Where counts were reported for “unknown” belt status for the four injury severity categories, we assigned the proportion of belted to unbelted occupants within each injury severity category to re-distribute the “unknown” belt status into “restrained” or “unrestrained” categories. Similarly, where counts were provided for “injured, severity unknown,” we assigned the proportion of each severity type within belt use category to redistribute occupants in the unknown category to one of the four injury severity categories. MDT, unlike Idaho, does not record “none evident” injuries.

¹⁶ Montana Trauma Registry data for 2010 and 2011 admissions, with E-Codes indicating Motor Vehicle Crash.

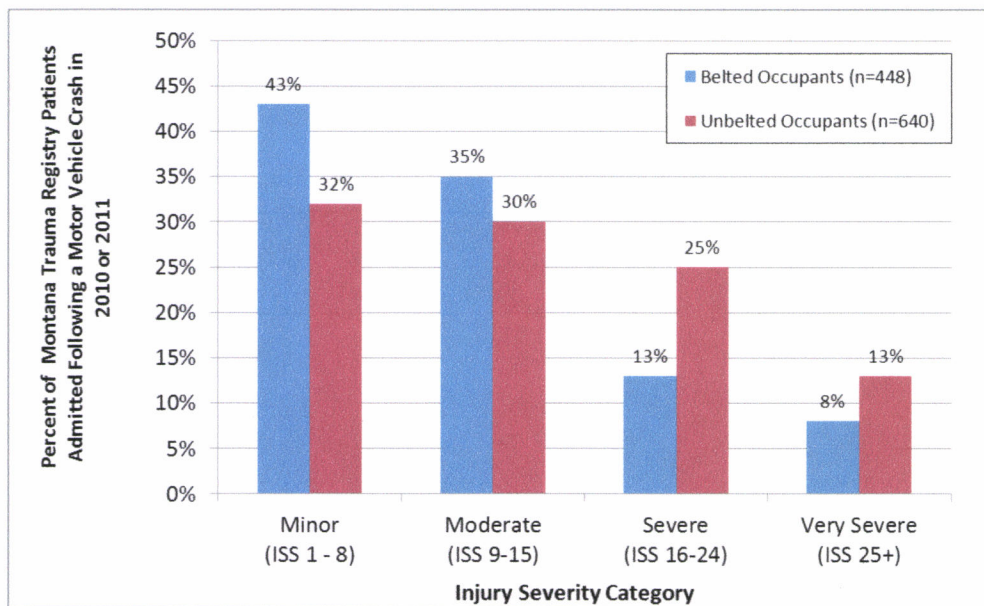


Figure 7. Hospital-Assigned Injury Severity Score by Restraint Use, for Patients Included in the Montana Trauma Registry following a Motor Vehicle Crash in 2010 or 2011.

- Among Montana crash occupants who required admission to a hospital in 2010 and 2011 following a motor vehicle crash, 59% were not belted, and 41% were belted¹⁷.
- During this same time period (2010-2011), an estimated 784 **unbelted** injured vehicle occupants were hospitalized for care.¹⁸ An estimated 368 of these hospitalizations could have been prevented if the occupants had worn a seat belt.¹⁹

¹⁷ Determined using 2010 and 2011 Montana Trauma Registry data for hospitalizations meeting trauma registry inclusion criteria and filtering out individuals with hospital length of stay < 1 day (as these are not admissions, but transfers either to home or another hospital), with the exception of those coded as deceased. Number of cases analyzed was 1,146. The analysis does not include data from patients transferred to Harborview Trauma Center in the State of Washington (e.g., those with the most serious injuries). Harborview Hospital trauma center data (the only Level 1 trauma center in the States of Washington, Alaska, Idaho, and Montana) were not available at the time this report was prepared.

¹⁸ Proportion of crash occupants hospitalized by police-reported injury classification was calculated using proportions provided by Dr. Beth Ebel (Harborview Injury Prevention & Research Center) based on a larger study using probabilistic matching to link Washington police-reported crash data to Washington State Hospital discharge data. Proportions applied to the Montana Transportation Department data were as follows: died (0.49744685), incapacitating injury (0.72990606), non-incapacitating injury (0.12669916), possible injury (0.02946386). In Washington, a fifth police-reported injury category ("none evident") was associated with a proportion of 0.00729243 injuries resulting in hospitalizations. However, as the Montana Transportation Department does not code this category of injuries, the number of estimated hospitalizations is likely underestimated for this analysis. However, even with this limitation, the Washington data were used to estimate hospitalizations in Montana (instead of the Montana Hospital Discharge Database), because Montana's Hospital Discharge Database has multiple limitations for this type of analysis: (a) there is no linkage to Transportation Department data, so neither restraint status nor police-reported injury severity is included; and (b) E-codes are only 87% complete for injuries, which would underestimate admissions resulting from MVCs. Trauma Registry data do not include all hospitalizations resulting from a MVC, only those meeting trauma registry inclusion. *[This footnote is continued on the next page.]*

- Unbelted occupants are less likely than belted occupants to have medical or automotive insurance that pays for their hospitalizations (58% vs. 74%), and are more likely to have their hospital costs paid from federal or state sources (Medicare, Medicaid, or Indian Health Services) than belted occupants (24% vs. 15%).²⁰ (See Figure 8).

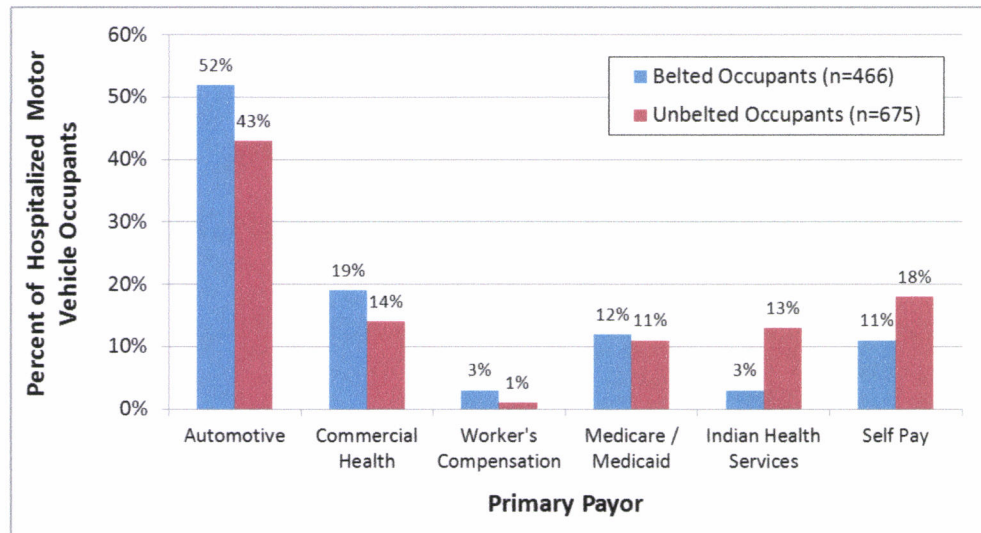


Figure 8. Primary Payor of Hospital Bill by Patient's Seat Belt Use, for Montanans Hospitalized following a Motor Vehicle Crash (2010 and 2011 Trauma Registry Data).

- Nearly one-fifth of unbelted occupants (18%) have no insurance (self-pay patients); their hospital costs are ultimately paid for by the state of Montana. Combining the payor categories of Self-Pay, Indian Health Services, and Medicare/Medicaid, 42% of unbelted occupants have their hospitalization costs paid for by state or federal sources. This compares to 26% of belted occupants.
- Unbelted occupants had higher average hospital charges than belted occupants (\$58,632 vs. \$49,803).²¹

Visit: www.dphhs.mt.gov/ems/trauma/coordinator/ppts/TraumaRegistry.ppt. Additionally, Trauma Registry data include duplicate admissions for patients transferred to other hospitals that report to the registry, making it an unreliable source for documenting total admissions.

¹⁹ Number of unbelted hospitalizations that could have been prevented if a seat belt had been worn was calculated by applying the proportion of the number belted occupants hospitalized to the number of belted crash involved (1,359/9648, or .14086) to the number of unbelted crash-involved occupants (.14086 x 2,954=416), and subtracting that from the number of unbelted crash occupants hospitalized (784-416 = 368).

²⁰ Primary payor data for 675 unbelted patients and 466 belted patients meeting trauma registry inclusion criteria were included in the 2010-2011 Montana Trauma Registry dataset (for patients with greater than 0 days length of stay, unless deceased).

²¹ Calculated using Montana Trauma Registry data for 2010 and 2011 admissions, for 646 unbelted patients, and 355 belted patients with hospital stays longer than 1 day. Two belted outliers (possible data entry errors) were excluded from analysis (both with costs exceeding \$3 million, for 1 and 4 days' stay, respectively, and Injury Severity Scores of only 8 and 9). Does not include patients admitted to a Level 1 trauma center; Harborview Trauma Center Data were not available at the time this report was prepared. Hospital Discharge Data could not be used for this analysis as restraint status is not included in the database.

- Caring for unbelted Montana patients during this period (2010-2011) costs over \$40,095,923 in direct hospital charges, which could have been prevented through seat belt use. These costs result from three sources:²²
 - More hospital admissions: 368 individuals requiring hospital care for preventable injury (368 x \$58,632 average unbelted admission = \$21,576,576).
 - Higher costs per hospital stay: 416 hospitalized individuals requiring \$8,829 more for their care than belted occupants (\$3,672,864)
 - Costs for emergency care²³: An estimated 10,192 unbelted occupants requiring emergency outpatient care, at an estimated average cost of \$1,456.68 each (\$14,846,483).
- On top of the hospital charges, doctor fees for unbelted occupants seen in the ER as well as those admitted to hospitals are estimated at \$8,019,185²⁴, resulting in total hospital and physician charges for unbelted occupants at \$48,115,108 in 2010 and 2011 (an average of \$24,057,554 per year).
- The estimated costs paid by state and federal sources (Medicaid, Medicare, and Indian Health Services) for unbelted occupants needing medical care in 2010 and 2011 were \$10,104,124 (an average of \$5,052,062 per year).²⁵

²² Costs were derived by applying average costs for unbelted patients from the Trauma Center data to the estimated number of unbelted patients admitted to hospitals (applying the Washington hospital proportions to the police-reported counts by injury status provided by the Transportation Department.) Does not include costs for patients transported and admitted to a Level 1 Trauma center (the most severely injured patients). Costs also do not include ambulance transport fees, any separately billed physician fees, or rehabilitation facility costs.

²³ Estimated based on 13 emergency visits for each admission due to motor vehicle crashes, and average cost of an ER visit for MVC in 2005 (Centers for Disease Control Data and Statistics / WISQARS Cost of Injury Reports 2005 http://wisqars.cdc.gov:8080/costT/cost_Part1_Finished.jsp and indexed to inflation for 2010 and 2011 using the inflation calculator and U.S. Medical Cost Inflation Data at: <http://www.halfhill.com/inflation.html>

²⁴ Professional fees estimated at 20% of facility fees (Pers. Comm., Dr. Beth Ebel, 8/29/2012). Does not include costs associated with patients admitted to a Level 1 trauma hospital (the most severely injured patients). Dollar amount refers to charges billed, and not those negotiated under agreements with large insurers.

²⁵ Based on the charges billed for the 42% unbelted occupants who were either self-pay, Medicaid, Medicare, or IHS (\$20,208,24) and then reduced by 50% using the Montana Medicare cost-to-charge ratio. The percentages were applied to counts of (a) patients whose hospitalizations could have been prevented and their associated costs, (b) the balance of the hospitalizations with higher costs than belted hospitalizations, and (c) the estimated number of ER patients. Does not include costs incurred by patients admitted to a Level 1 trauma hospital. Proportion of Federal to State charges could not be determined, because trauma registry data combined Medicare/Medicaid as a primary payor.

Projected Health Care Cost Savings From Primary Enforcement

To calculate a (maximum) potential savings in health care costs as the result of primary enforcement in Montana and Idaho, it is first necessary to estimate an increase in belt use that could be anticipated in each State. These estimates must be reasonable and appropriate with respect to published data in this area, *and* they must be reconciled with the base level against which the projected savings are to be calculated. The base level in each State is the percentage of restrained occupants in the police-reported crashes for 2011 in Idaho and Montana, i.e., 92.4% and 76.6%, respectively (see Tables 1 and 5 below). The value for Montana, 76.6%, conforms closely to the 2011 NOPUS rate of 76.9% for this state; but the value for Idaho, 92.4%, is well above its 2011 NOPUS rate of 79.1%.²⁶

Relevant data in this area include estimates of the impact of primary seat belt laws (versus secondary laws) published by NHTSA that indicate a range of 10- to 12-percentage-point increases in seat belt use among occupants observed during daytime.²⁷ This suggests an 11-point increase as a reasonable estimate for these calculations. Applying an hypothesized increase of this magnitude to Montana would raise its belt use rate for the 2011 dataset from 76.6% to 87.6% which provides a feasible starting point for this analysis. However, it is not feasible to hypothesize an increase of this magnitude in Idaho when the 2011 dataset we are working with already indicates a belt use rate among crash-involved vehicle occupants of 92.4%. Accordingly, with the goal of projecting the maximum savings possible, we have hypothesized that primary enforcement in Idaho could raise its belt use rate (for the current data set of police-reported crashes) to the highest rate observed among the States in 2011, 97.5% (for the State of Washington). This translates to a 5.1% improvement for Idaho.

These hypothesized gains in belt use through primary enforcement—11% for Montana and 5.1% for Idaho—were applied to generate revised distributions of belted and unbelted crash victims by crash severity level, for the year 2011 only, assuming the same total number of occupants in motor vehicle crashes as taken from the police reports and utilized in the prior analyses. These revised distributions, in turn, formed the starting point for calculations to project the maximum cost savings possible in Idaho and Montana, as described below.

Idaho

Table 1 provides the counts of injured occupants in Idaho by injury status and seat belt use in 2011, based on data provided by the Idaho Transportation Department (see Appendix A), with occupants of unknown seat belt status distributed into no restraint and seat belt categories the same as in the Idaho analysis described above.

This analysis proceeded under the assumption that the number of injured occupants would remain at 48,180 if a primary belt law were implemented, but instead of 92.4% of them being belted (44,516/48,180), 97.5% would be belted (an increase of 5.1%). Therefore, the number of belted injured occupants would be 46,976 (97.5% of 48,180) and the number of

²⁶ DOT HS 811 651, "Seat Belt Use in 2011—Use Rates in the States and Territories."

²⁷ Traffic Tech Number 400, "Primary Laws and Fine Levels are associated with Increases in Seat Belt Use, 1997-2008."

unbelted injured occupants would be 1,204 (48,180 minus 46,976). A new table of expected injury counts by injury severity and seat belt use was developed, by dividing the number of occupants within an injury and restraint status cell to the total number of injured occupants within a restraint category in Table 1, then applying that proportion to the total number of injured occupants within a restraint category in Table 2, to calculate the expected counts for each cell as shown in Table 2. For example, to calculate the number of unbelted occupants with a 'possible' injury in Table 2, the number presented in Table 1 (562) was divided by the total number of unbelted injured occupants in Table 1 (3,664), yielding 0.153384279, then this proportion was multiplied by the total number of unbelted injured occupants in Table 2 (1,204), yielding 185 (rounded up).

As described in the earlier analysis, the number of injured occupants requiring hospitalization, by injury category, was calculated using proportions of injured occupants to hospitalized occupants derived from a research study conducted in Washington State. That is, 0.49744685 of those who died within 30 days of the crash were hospitalized; 0.72990606 of those with an incapacitating injury were hospitalized; 0.12669916 of those with a non-incapacitating injury were hospitalized; 0.02946686 of those with a possible injury were hospitalized; and .00729243 of those with no evident injuries were hospitalized. Applying these proportions to the counts shown in Tables 1 and 2, result in the counts of expected hospitalizations for the year 2011 shown in Table 3 (with present secondary belt law) and Table 4 (with a primary belt law enacted).

Table 1. Counts of Injured Occupants in 2011 Crashes in Idaho, by Seat Belt Status and Injury Severity Level Under the Current (Secondary) Seat Belt Law.

Occupant Protection	Injury Severity					Total
	None Evident	Possible Injury	Non-Incapacitating Injury	Incapacitating Injury	Fatal Injury	
No Restraint	2,267	562	453	299	83	3,664
Seat Belt	36,191	5,227	2,365	689	44	44,516
Total	38,458	5,789	2,818	988	127	48,180

Table 2. Expected Counts of Injured Occupants in 2011 Crashes in Idaho, by Seat Belt Status and Injury Severity Level Assuming an Increase in Belt Use of 5.1% as the Result of Primary Enforcement.

Occupant Protection	Injury Severity					Total
	None Evident	Possible Injury	Non-Incapacitating Injury	Incapacitating Injury	Fatal Injury	
No Restraint	745	185	149	98	27	1,204
Seat Belt	38,191	5,516	2,496	727	46	46,976
Total	38,936	5,701	2,645	825	73	48,180

Table 3. Expected Number of Hospitalized Occupants in 2011 in Idaho by Seat Belt Status and Injury Severity Level, Under the Present (Secondary) Seat Belt Law.

Occupant Protection	Injury Severity					Total
	None Evident	Possible Injury	Non-Incapacitating Injury	Incapacitating Injury	Fatal Injury	
No Restraint	17	17	57	218	41	350
Seat Belt	264	154	300	503	22	1,243
Total	281	171	357	721	63	1,593

Table 4. Expected Number of Hospitalized Occupants in 2011 in Idaho by Seat Belt Status and Injury Severity Level Assuming an Increase in Belt Use of 5.1% as the Result of Primary Enforcement.

Occupant Protection	Injury Severity					Total
	None Evident	Possible Injury	Non-Incapacitating Injury	Incapacitating Injury	Fatal Injury	
No Restraint	5	5	19	72	13	114
Seat Belt	278	163	316	531	23	1,311
Total	283	168	335	603	36	1,425

- A 5.1% increase in seat belt use by the 48,180 occupants injured in motor vehicle crashes in 2011, would result in 54 fewer fatalities (a 42.5% decrease), 163 fewer incapacitating injuries (a 16.5% decrease), 173 fewer non-incapacitating injuries (a decrease of 6.1%), 88 fewer possible injuries (a 1.5% decrease), and an increase in none evident injuries (478 more, representing an increase of 1.2%). The increase in non-evident injuries is the result of the more serious injuries and fatalities shifting to less serious injury categories.
- The decrease in fatalities and serious injuries resulting from implementing a primary seat belt law (and the associated 5.1% increase in seat belt use) would result in fewer hospitalizations and emergency department visits for unbelted occupants. In 2011, the number of hospitalizations for injured unbelted occupants would decrease from 350 to 114 (a decrease of 67.4%). The number of emergency room visits for injured unbelted occupants would be reduced from 4,550 to 1,480 (a decrease of 67.4%).
- Estimated hospital and professional fees for unbelted occupants' hospitalizations and emergency room visits would be reduced from \$22,279,326 per year to \$6,809,138 (a reduction of \$15,470,188 in billed charges per year, or a decrease of 69.4%).

- Assuming that the same percentage of the unbelted injured occupants would have their medical bills paid for by state or federal sources (21% in 2011), and using the Medicare cost to charge ratio of 50%, the estimated annual cost of medical care (hospital costs, plus professional fees estimated at 20% of hospital costs) paid for by taxpayer dollars for unbelted occupants would be \$717,989 if a primary belt law were enacted. This compares to \$2,342,113 under the present secondary, and represents an annual savings to taxpayers of \$1,624,124 (a decrease of 69.3%).

Montana

Table 5 provides the counts of injured occupants in Montana by injury status and seat belt use in 2011, based on data provided by the Montana Transportation Department (see Appendix B), with occupants of unknown seat belt status distributed into no restraint and seat belt categories the same as in the Montana analysis described above.

The analysis proceeded under the assumption that the number of injured occupants would remain at 6,170 if a primary belt law were implemented, but instead of 76.6% of them being belted (4,727/6,170), 87.6% would be belted (an increase of 11%). Therefore, the number of belted injured occupants would be 5,405 (87.6% of 6,170) and the number of unbelted occupants would be 765 (6,170 minus 5,405). A new table of expected injury counts by injury severity and seat belt use was developed, by dividing the number of occupants within an injury and restraint status cell to the total number of injured occupants within a restraint category in Table 5, then applying that proportion to the total number of injured occupants within a restraint category in Table 6, to calculate the expected counts for each cell as shown in Table 6. For example, to calculate the number of unbelted occupants with a 'possible' injury in Table 6, the number presented in Table 5 (307) was divided by the total number of unbelted injured occupants in Table 5 (1,443), yielding 0.212751212, then this proportion was multiplied by the total number of unbelted injured occupants in Table 6 (765), yielding 163.

As described in the earlier analysis, the number of injured occupants requiring hospitalization, by injury category, was calculated using proportions of injured occupants to hospitalized occupants derived from a research study conducted in Washington State. That is, 0.49744685 of those who died within 30 days of the crash were hospitalized; 0.72990606 of those with an incapacitating injury were hospitalized; 0.12669916 of those with a non-incapacitating injury were hospitalized; and 0.02946686 of those with a possible injury were hospitalized. Applying these proportions to the counts shown in Tables 5 and 6, result in the counts of expected hospitalizations for the year 2011 shown in Tables 7 (with present secondary belt law) and Table 8 (with a primary belt law enacted).

Table 5. Counts of Injured Occupants in 2011 Crashes in Montana, by Seat Belt Status and Injury Severity Level Under the Current (Secondary) Seat Belt Law.

Occupant Protection	Injury Severity				Total
	Possible Injury	Non-Incapacitating Injury	Incapacitating Injury	Fatal Injury	
No Restraint	307	733	286	117	1,443
Seat Belt	2,342	1,884	450	51	4,727
Total	2,649	2,617	736	168	6,170

Table 6. Expected Counts of Injured Occupants in 2011 Crashes in Montana, by Seat Belt Status and Injury Severity Level Assuming an Increase in Belt Use of 11% as the Result of Primary Enforcement.

Occupant Protection	Injury Severity				Total
	Possible Injury	Non-Incapacitating Injury	Incapacitating Injury	Fatal Injury	
No Restraint	163	388	152	62	765
Seat Belt	2,678	2,154	515	58	5,405
Total	2,841	2,542	667	120	6,170

Table 7. Expected Number of Hospitalized Occupants in 2011 in Montana by Seat Belt Status and Injury Severity Level Under the Present (Secondary) Seat Belt Law.

Occupant Protection	Injury Severity				Total
	Possible Injury	Non-Incapacitating Injury	Incapacitating Injury	Fatal Injury	
No Restraint	9	93	209	58	369
Seat Belt	70	239	329	25	663
Total	79	332	538	83	1,032

Table 8. Expected Number of Hospitalized Occupants in 2011 in Montana by Seat Belt Status and Injury Severity Level Assuming an Increase in Belt Use of 11% as the Result of Primary Enforcement.

Occupant Protection	Injury Severity				Total
	Possible Injury	Non-Incapacitating Injury	Incapacitating Injury	Fatal Injury	
No Restraint	5	49	111	31	196
Seat Belt	80	274	376	29	759
Total	85	323	487	60	955

The data in Tables 5 and 6 were used to determine the annual safety benefit of implementing a primary seat belt law, while the data in Tables 7 and 8 were used to determine the annual health cost savings, using the methods described earlier.

- An 11% increase in seat belt use by the 6,170 occupants injured in motor vehicle crashes in 2011, would result in 48 fewer fatalities (a 28.6% decrease), 69 fewer incapacitating injuries (a 9.4% decrease), 75 fewer non-incapacitating injuries (a decrease of 2.9%), and 192 more possible injuries (an increase of 7.2%). The increase in possible injuries is the result of the more serious injuries and fatalities shifting to less serious injury categories.
- The decrease in fatalities and serious injuries resulting from implementing a primary seat belt law (and the associated 11% increase in seat belt use) would result in fewer hospitalizations and emergency department visits for unbelted occupants. In 2011, the number of hospitalizations for injured unbelted occupants would decrease from 369 to 196 (a decrease of 46.9%). The number of emergency room visits for injured unbelted occupants would be reduced from 4,797 to 2,548 (a decrease of 46.9%).
- Estimated hospital and professional fees for unbelted occupants' hospitalizations and emergency room visits would be reduced from \$24,057,554 per year to \$11,849,486 per year (a reduction of \$12,208,068 in billed charges per year, or a decrease of 51%).
- Assuming that the same percentage of the unbelted injured occupants would have their medical bills paid for by state or federal sources (42%), and using the Medicare cost to charge ratio of 50%, the estimated annual cost of medical care (hospital costs, plus professional fees estimated at 20% of hospital costs) paid for by taxpayer dollars for unbelted occupants would be \$2,475,201 if a primary belt law were enacted. This compares to the estimate derived for the year 2011 under the present secondary belt law of \$5,052,062, and represents an annual savings to taxpayers of \$2,576,861 (a decrease of 51%).

Discussion

The present analyses indicate that substantial savings may result in both Idaho and Montana from increases in the percentage of belted occupants involved in motor vehicle crashes, due to primary enforcement. The specific projections of potential savings must be strongly qualified, however, as a consequence of the missing or incomplete data (and the assumptions used to generate estimates for these data elements) as cited throughout this report.

Certain inconsistencies with related studies also deserve mention. First, the extraordinary level of belt use – over 92% -- indicated by Idaho police reports is certainly elevated in comparison with use rates in this State based on observation studies. As a reminder, this level was calculated by apportioning the minority of cases where belt use was “unknown” into a given injury severity category in the same proportion as reflected in the unrestrained versus restrained data for that same category. Of course, if we had simply disregarded the “unknown belt use” data and excluded it from the analysis of potential cost savings in Idaho, the result would be the same, i.e., a ‘base level’ belt use rate among 2011 crash-involved vehicle occupants of 92.4%. Even if *all of the unknowns had been reclassified as unbelted*, this base level belt use rate would be 87%, which is still elevated compared to observational data; and there is no justification for doing this.

Next, the earlier Harborview Injury Prevention Center report concerning seat belt use and health care costs in Montana, that was the subject of the update in this task, reported higher numbers of drivers injured and killed, and consequently higher estimates of unbelted injured vehicle occupants hospitalized for care, than in the present analyses. The Harborview analysis, which examined data for the years 2005-2009, referenced a total of 984 total passenger vehicle fatalities in Montana during this period, and noted that over two-thirds of fatally-injured vehicle occupants were unbelted. In this context it is interesting to look at the trends in total passenger vehicle fatalities over this period (and for the following year, 2010) based on a FARS query. As shown in Table 9, there is a consistent downward trend. At the same time that the total number of fatalities has been declining, unrestrained passenger vehicle fatalities in Montana *decreased by approximately 28%* (and by 32% in Idaho). The number of police-reported passenger vehicle fatalities in both states used in the present analyses match the FARS data; we must assume that the number of non-fatally injured crash victims, and their belt use status, is similarly reliable.

Table 9. Total Passenger Vehicle Occupant* Fatalities 2005-2010 (Source: FARS).

YEAR	IDAHO	MONTANA
2005	225	199
2006	211	214
2007	192	205
2008	171	167
2009	163	163
2010	156	147

* Includes passenger cars and light trucks/SUVs **ONLY**; **excludes** large trucks, buses, and motorcycles.

It is anticipated that continuing efforts to update these analyses in the ensuing Task Order will obtain data now missing or incomplete and, where data remain unavailable, may refine the methods used to generate estimates through guidance from NHTSA staff who review this report. This should improve the accuracy of the resulting projections for cost savings, and may help further explain the lower estimates presented in this report relative to the Harborview study.

APPENDIX A:

**POLICE-REPORTED COUNTS OF OCCUPANTS INJURED BY INJURY
SEVERITY CATEGORY AND RESTRAINT STATUS FOR 2010 AND 2011
(PROVIDED BY IDAHO DEPARTMENT OF TRANSPORTATION)**

Person-Level Cross-Tab Report for Reportable Accidents Only, Accident Year = 2010

Restraint Status	Injury Severity					Total
	None Evident	Possible	Non- Incapacitating	Incapacitating	Dead	
Unrestrained	2,648	665	570	319	73	4,275
Restrained	36,944	5,319	2,270	706	74	45,313
Unknown	2,141	341	131	48	9	2,670

Person-Level Cross-Tab Report for Reportable Accidents Only, Accident Year = 2011

Restraint Status	Injury Severity					Total
	None Evident	Possible	Non- Incapacitating	Incapacitating	Dead	
Unrestrained	2,126	530	428	285	78	3,447
Restrained	33,982	4,936	2,236	656	42	41,852
Unknown	2,350	323	154	47	7	2,881

APPENDIX B:

**POLICE-REPORTED COUNTS OF OCCUPANTS INJURED BY INJURY SEVERITY CATEGORY
AND RESTRAINT STATUS FOR 2010 AND 2011 (PROVIDED BY MONTANA DEPARTMENT OF
TRANSPORTATION)**

Jan 1, 2010 to Dec 31, 2010

Occupant Protection	Injury Severity				
	Possible Injury	Non-Incapacitating Injury	Incapacitating Injury	Fatal Injury	Injured, Severity Unknown
No Restraint	227	697	321	93	49
Seat Belt*	1,949	1,770	440	51	118
Unknown	479	149	40	8	41

*Combined categories of shoulder belt only used, lap belt only used, shoulder and lap belt used

Jan 1, 2011 to Dec 31, 2011

Occupant Protection	Injury Severity				
	Possible Injury	Non-Incapacitating Injury	Incapacitating Injury	Fatal Injury	Injured, Severity Unknown
No Restraint	253	694	270	115	0
Seat Belt*	1,931	1,783	425	50	0
Unknown	465	140	41	3	0

*Combined categories of shoulder belt only used, lap belt only used, shoulder and lap belt used